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ABSTRACT

A preliminary model was developed for predicting mail survey response rates of college bound high school students using student demographic and academic ability data. Two samples of high school juniors and seniors who took the American College Testing (ACT) Assessment between October 1987 and February 1988 were selected. One sample (n=810) included students selecting agriculture or a related area as an academic major at the time they completed the ACT Assessment. The other sample (n=2,549) consisted of students who had selected college majors in non-agriculture related areas or were undecided about majors. The questionnaire contained a series of questions related to choice of major and to agricultural interests. It was hypothesized that students from Sample 1 would respond at a higher rate than would those in Sample 2. The overall response rate for both samples was 40.7%; 1,367 usable surveys were returned. There was no significant difference in response rate between Sample 1 and Sample 2. Responders were more likely to be females, with high ACT scores, good high school grades, and no intent to obtain financial aid to help pay for college. Results indicate that knowledge of students' demographic and academic characteristics can help survey researchers design mail surveys. A model is constructed, using effects for background characteristics, academic characteristics, personality characteristics, interest in survey content, and effects for survey characteristics. This model is proposed as a basis for future research. Six tables and one figure present study data. (SLD)

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TOWARD DEVELOPMENT OF A MODEL FOR PREDICTING MAIL SURVEY RESPONSE RATES OF COLLEGE BOUND HIGH SCHOOL STUDENTS: RESULTS OF A NATIONAL SURVEY

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INTRODUCTION

In spite of recent trends toward telephone surveys, many colleges and universities rely on mail surveys to obtain data from college bound high school students for developing marketing plans, devising recruiting strategies, planning new programs and services, and conducting research. In many cases no reliable means exists for estimating response rates for this population or for targeted subgroups; therefore problems associated with undersampling or oversampling occur.

A number of reviews of studies dealing with response rates to mail surveys (Berdie and Anderson, 1986; Duncan, 1979; Kanuk and Berenson, 1975) have been reported in the literature over the years. The majority of these reviews, however, were concerned with methods for increasing response rates, such as using various kinds of postage, including monetary incentives, or varying the degree of personalization (Anderson, 1970; Armstrong and Lusk, 1987; Harvey, 1988; Linskey, 1965; Martin and McConnell, 1970; Smith and Bers, 1987; Wolfe and Treiman, 1979). Other common topics of research related to mail surveys have included the estimation of response bias (Baur, 1947; Filion, 1975; Hogan, 1985), the analysis of response quality (Berger and Sullivan, 1970; Eckland, 1965; Holdaway, 1971; Krosnick and Alwin, 1987; Poe, et. al., 1988), the comparison of mail surveys with other survey methods (Dillman, 1978; Gibson and Hawkins, 1968; Hochstin, 1967), and the comparison of respondent characteristics with those of nonrespondents (Bebbington, 1970; Bennett and Hill, 1964; Creech, 1975; Lubin, Levitt, and Zuckerman, 1962; Reuss, 1943). Despite this abundance of research on response rates to mail surveys there are relatively few studies that have attempted to provide guidelines for estimating response rates to mail surveys for specific populations, such as students enrolled in vocational education programs or

college bound high school students. The studies that are available have attempted to formulate generalized response rate models that are based on reviews of the literature, such as the model proposed by Huxley (1980), or pilot surveys, such as the model proposed by Parasuraman (1982). Both models, while useful, do not take respondent characteristics into account; rather, these models are based mainly on response flow over time. Huxley's model, for example, proposes that response rate can be determined by the general exponential model (Huxley, 1980):

$$\frac{Rt}{N} = 1-b', \text{ where:}$$

Rt = number of responses at end of week t

N = number of questionnaires mailed initially

b' = the degree of "resistence" from respondents in returning the questionnaire

Recent surveys conducted by ACT's Survey Services Department, however, suggest that college bound high school students tend to respond at a higher rate to mail surveys than does the general population. In addition, analysis of subgroup responses for this population (i.e., students selecting a particular college major or students residing in specific geographic areas) suggests that response rate differences can be observed on the basis of certain demographic and academic characteristics. Because these findings were based on relatively small scale surveys or on surveys of specific subgroups of the population of college bound high school students, a decision was made to examine the response rates and response patterns from a large, nationally representative sample of college bound high school students in order to estimate expected return rates to mail surveys for that group.

PURPOSE OF THE STUDY

The primary purpose of the study was to develop a preliminary model for predicting mail survey response rates of college bound high school students using student demographic and academic ability data.

LIMITATIONS OF THE STUDY

The study's major limitations are presented below.

1. The study was limited to ACT Assessment tested high school juniors and seniors. As a result, students who completed other college entrance examinations or who did not take college entrance examinations are not represented in the sample population. However, because the ACT Assessment is completed each year by over one million students, representing all 50 states and the District of Columbia, the results of the study may well be generalizable to all college bound high school students in the U.S.

2. The survey project was carried out during the summer of 1988 (July-August). Because summer is not an optimal time to survey high school students, response rates and response patterns may not be similar to those obtained from surveys administered during the academic school year.

METHODOLOGY

Data Source

The sample frame for the survey consisted of ACT-tested high school juniors and seniors who completed the ACT Assessment between October, 1987 and February, 1988. Two stratified random samples were selected from this population proportionally, by state size based on the population distribution of the United States according to official 1985 U.S. Census Bureau data. Within each state, sample members were selected randomly. Sample 1, (N=810) consisted of students who had selected agriculture or a related area as an academic major at the time they completed the ACT Assessment. Sample 2, (N=2,549) consisted of students who had selected college majors in non-agriculture related areas or who were undecided about majors. These sample

sizes were necessary to attain the degree of statistical precision (±.05 for Sample 1 and ±.03 for Sample 2) specified by the research design.

Questionnaire Design

The questionnaire, entitled "A Survey of Academic and Career Plans," was developed for a project sponsored by The Farm Foundation, a not-for-profit corporation that is concerned with improving the status of agriculture, with agriculture education, and with agriculture-related careers in the United States. The questionnaire (copy available upon request) contained a series of questions related to choice of college major and career followed by an extensive series of questions and scales related to students' impressions and knowledge of majors and careers in agriculture and agribusiness. The questionnaire was a 12 page typeset booklet featuring an interesting cover design intended to induce interest in participation.

Because the bulk of the questionnaire's content concerned agriculture-related issues, it was hypothesized that students from Sample 1 would respond at a significantly higher rate that would students from Sample 2. This hypothesis was based on evidence from published research that, although somewhat dated, indicated a direct relationship between mail survey response rates and subject interest in the content of the questionnaire (Baur, 1947; Donald, 1960; Edgerton, Britt, and Norman, 1947).

Survey Administration

Sample members first received a postcard (mailed July 18, 1988) informing them of their selection for the survey project and soliciting their cooperation. The survey packets were then mailed (July 25-26, 1988) using first-class postage. Each packet contained a questionnaire, a business reply envelope, and a cover letter in which the nature and importance of the survey project and sample selection procedures were described, and the importance of

the sample member's participation was stressed. A postcard was then sent August 3, 1988 to all sample members reminding them of the survey project and asking that they respond if they had not already done so. A second survey packet (containing the questionnaire, a revised cover letter, and a business reply envelope) was mailed August 15, 1988 by first-class postage to all nonrespondents ending survey administration activities. The cutoff date for return of completed surveys was September 12, 1988.

Variables

Variables included in the study and their coded values are presented in Table 1. These variables were selected from those identified in previous ACT survey projects (mentioned earlier in this paper) and through a review of the literature on mail survey response rates. For example, researchers have observed relationships between mail survey response rates and variables such as education level (Bebbington, 1970; Creech, 1975; Gannon et. al., 1971), race (Mayer and Pratt, 1966), gender (Crossley and Fink, 1951), aptitude (Edgerton et. al., 1947; Bebbington, 1970), and geographic region of residence (Hawkins, 1977; Reuss, 1943).

Table 1: Variables and Coding Scheme Used in the Study

Variable	Values
Dependent Variable:	
Responder/Nonresponder	Responder=1; Nonresponder=0
Independent Variables:	
Gender	Male=1; Female=2
Race/Ethnicity (5 variables)	White=1; Non White=0 Black=1; Non Black=0 Hispanic=1; Non Hispanic=0 Other Minority=1; White, Black, Hispanic=0 Foreign/No Race Specified=1; All Others=0
High School Grade Average	D- to D = 1 D to C- = 2 C- to C = 3 C to B- = 4 B- to B = 5 B to B+ = 6 A- to A = 7
ACT Composite Score	0-36 (ACT Standard Score)
Geographic Region of Residence (6 variables: lives in region=1; lives outside region=0)	Eastern Southern Midwestern Southwestern Mountain/Plains Western
Agriculture/Non Agriculture Major	Ag Major=1; Non Ag Major=0
Need for Financial Aid	Need=1; No Need=0
Expected Educational Goal	Less Than Two-Year Degree=1 Two-Year Degree=2 Bachelor's Degree=3 One or two year's graduate study (MA, MBA, etc.)=4 PhD/MD, Etc.=5
Family Income	<$ 6,000=0 $ 6,000-11,999=1 $12,000-17,999=2 $18,000-23,999=3 $24,000-29,999=4 $30,000-35,999=5 $36,000-41,999=6 $42,000-49,999=7 $50,000-59,999=8 $60,000+=9

(Continued)

Variable	Values	
Size of Home Community	Farm or open country=1	10,000-49,999=5
	Town or city of:	50,000-249,999=6
	< 500=2	250,000-499,999=7
	500-1,999=3	500,000-999,999=8
	2,000-9,999=4	>1,000,000=9
Class in High School	Junior=1; Senior=2	

Data Analysis

Data were initially analyzed by entering all independent variables into a SAS GLM model. Next, the Student-Newman-Keuls (SNK) multiple range test for all main effects means specified in the model was used to determine variables for which subgroups differed significantly. The SNK is a step-down multiple stage test that first tests the homogeneity of all the means at a level γ_k. If the test results in a rejection, then each set of k-1 means is tested at level γ_{k-1} (SAS, 1985, p. 474). In general, if the hypothesis of homogeneity of a set of p means is rejected at the γ_p level, then each subset of p-1 means is tested at the γ_{p-1} level; otherwise, the set of p means is considered not to differ significantly and none of its subsets are tested. The SNK method holds the experimentwise error rate under the complete null hypothesis to the α level, but does not control the experimentwise error rate under a partial null hypothesis. As a result, as the number of means being compared increases, the probability of at least one false rejection of the null hypothesis (Type 1 error) increases. Therefore, to verify the SNK results for cases where $k>2$, the data were reanalyzed using Tukey's studentized range test; no change in the outcome for each set of paired means resulted. The SNK results were then used to specify a model for a logistic regression analysis using the LOGIST procedure available in SAS. LOGIST fits a logistic regression model, appropriate for a single binary (0, 1) dependent variable, such as response/nonresponse.

RESULTS

A total of 1,367 usable surveys were returned by the cutoff date, for an overall response rate of 40.7%. This response rate was somewhat lower than that anticipated for the survey, but the survey length (12 pages) and the timing of the survey administration (July-August) may have adversely affected the return rate. Response rates for major subgroups of the study population are presented in Table 2.

Table 2: Response Rates for Major Subgroups

Sub Group	Number in Sample	Number of Respondents	Response Rate
Agriculture Majors	810	337	41.6%
Non Agriculture Majors	2,549	1,030	40.4%
Females	1,622	757	46.7%
Males	1,737	610	35.1%
White/Caucasians	2,505	1,075	42.9%
Black/African American	457	140	30.6%
Hispanic/Mexican American	142	49	34.5%
Family Income <$18,000	817	300	36.7%
Family Income $18,000-35,999	1,211	507	41.9%
Family Income >$35,999	1,331	560	42.1%
Live on Farm/Rural Area	848	323	38.1%
Live in Small-Medium City	1,578	673	42.6%
Live in Large City	933	371	39.8%

As indicated in Table 2, response rate differences were observed for major subgroups of the population, most noticeably for subgroups based on sex and on racial/ethnic group. To determine significant differences in return rate by subgroup, all main effects means for variables in the GLM model were tested using the SNK procedure for testing multiple means. Results are presented in Table 3.

Table 3: SNK Results for Subgroups of the Sample Population

Subgroup (Subgroup #)	Mean	Difference in Paired Means	Critical Range (Two-tailed SNK)	Significant at .01 level (pairs)
Gender: Male	.351	.116	.032	YES
Female	.467			
Ag Sample	.416	.012	.037	NO
Non Ag Sample	.404			
Income: <18,000 (1)	.367	.052 (1,2)		YES (1,2)
18,000-35,999 (2)	.419	.054 (1,3)		YES (1,3)
>36,000 (3)	.421	.002 (2,3)	.040	NO (2,3)
Home: Farm/rural (1)	.380	.046 (1,2)		YES (1,2)
2,000-49,999 (2)	.426	.018 (1,3)		NO (1,3)
>50,000 (3)	.398	.028 (2,3)	.040	NO (2,3)
Race: Black	.306	.117	.047	YES
Non-Black	.423			
Race: Hispanic	.345	.065	.079	NO
Non-Hispanic	.410			
Race: White	.429	.087	.037	YES
Non White	.342			
Race: Other Minority	.312	.107	.063	YES
White/Black/Hispanic	.419			
Race: Foreign/No Race Specified	.335			
All Others	.422	.087	.074	YES
High School Average:				
D- to C-	.200	.113 (1,2)		NO (1,2)
C- to B-	.313	.146 (1,3)		YES (1,3)
B- to B+	.346	.317 (1,4)		YES (1,4)
A- to A+	.517	.033 (2,3)	.133	NO (2,3)
		.204 (2,4)		YES (2,4)
		.171 (3,4)		YES (3,4)
Financial Aid Recipient:				
YES	.338			
NO	.457	.119	.045	YES

(Continued on next page)

Subgroup (Subgroup #)	Mean	Difference in Paired Means	Critical Range (Two-tailed SNK)	Significant at .01 level (pairs)
ACT Score 0-13 (1)	.317	Range	.051	All possible
14-18 (2)	.380	from		combinations
19-23 (3)	.452	.063 to		of means were
24-36 (4)	.552	.235		significantly different.
Educational Goal:				
2 YR Degree or Less	.351	.059 (1,2)		YES (1,2)
4 YR Degree	.410	.093 (1,3)	.052	YES (1,3)
Graduate/Professional School	.444	.034 (2,3)		NO (2,3)
Region: Eastern (1)	.411			None of the
Southern (2)	.380	Range		possible
Midwestern (3)	.437	from	.068	combinations
Southwestern (4)	.407	.009 to		of means was
Mountain/Plains (5)	.419	.057		significantly
Western (6)	.410			different.
Class in High School: Junior	.410	.005	.034	NO
Senior	.405			

The data contained in Table 3 suggest that significant differences in response rates for this population can be expected on the basis of gender (females responding at a significantly higher rate than males), income (students with family incomes of $18,000 or higher responding at a significantly higher rate than those with family incomes of less than $18,000), home town size (medium size city students responding at a significantly higher rate than farm/rural students), race (nonblacks responding at a significantly higher rate than blacks; whites responding at a significantly higher rate than non-whites), ACT score (the higher the ACT score the greater the probability of responding), high school average (the higher the high school average the greater the probability of responding), and plan to receive financial aid (those not planning to receive financial aid

responding at a significantly higher rate than those planning to receive financial aid). Surprisingly, there was no significant difference in mean response on the basis of sample membership, even though students from the Ag Sample did respond at a slightly higher rate than students from the Non Ag Sample. (This result could be confounded by the fact that over 80% of Ag sample members were males and, as a group, the Ag sample had lower ACT scores and high school averages than Non Ag sample members.)

The next step in analyzing the data was the logistic regression analysis. Because no significant differences in mean response rate were found on the basis of geographic region of residence or class in high school those two variables were not included in the logistic model. In addition, the dummy variable corresponding to "white" students was left out of the equation in order to obtain unique estimates for the minority groups specified in the equation. Because results for the variable "sample membership" could have been confounded by the effects of the Ag sample composition, however, sample membership was included in the model. The results of the logistic regression analysis are presented in Table 4.

Table 4: Logistic Regression Results for the Sample Population

VARIABLE	BETA	STD. ERROR	CHI-SQ	P
Intercept	-2.580			
Gender	0.530	0.08	40.45	.0000
Sample Group	0.294	0.10	8.63	.003
H.S. Average	0.202	0.04	24.46	.0000
ACT Score	0.050	0.01	30.02	.0000
Financial Aid	-0.327	0.10	10.11	.002
Size of Home Town	-0.050	0.02	6.25	.012
Educational Goal	-0.062	0.04	1.94	.163
Family Income	-0.006	0.02	0.14	.706
Black	-0.011	0.19	0.00	.952
Hispanic	-0.335	0.22	2.39	.122
Other Minority	0.036	0.16	0.05	.826
Foreign/No Race Specified	-0.215	0.25	0.71	.399

Using the results of the logistic regression analysis, it is possible to estimate that the highest response rate was from females with high ACT scores, good high school grade averages, and no intent to obtain financial aid to help pay for college. Students from medium sized cities who planned to obtain a two-year degree or less responded at a slightly higher rate than did students from smaller communities who planned to obtain 4-year or advanced degrees. The lowest response rate was from Hispanic males with low ACT scores, poor high school grades, and intent to apply for financial aid.

Holding all other variables constant, a one unit increase[1] in each variable in the model affected the odds of responding to the survey as indicated in Table 5.

Table 5: Odds of Increasing/Decreasing Response to a Mailed Survey, Holding all Other Variables Constant, With a One Unit Increase in a Variable

VARIABLE	PERCENTAGE INCREASE (+)/DECREASE (-) IN THE ODDS OF RESPONDING
Gender	+70%
Sample Group	+34%
H.S. Average	+22%
ACT Score	+ 5%
Financial Aid	-28%
Size of Home	- 5%
Educational Goal	- 6%
Family Income	- 1%
Black*	- 1%
Hispanic*	-28%
Other Minority*	+ 4%
No Race Specified*	-19%

* Relative to White students

[1] For example, when all other variables in the model are held constant, the odds of responding are 70% greater for females than for males, or 10% greater for a student with an ACT score of 20 than for a student with an ACT score of 18. The odds of responding are 1% less for blacks than for whites. Note that when other variables are held constant, race does not appear to affect response rate to a great extent. Also, it appears that when controling for other variables, sample membership did impact response rate, with the odds of responding 34% higher for Ag sample members than for Non Ag sample members. Apparently, the composition of the Ag sample (mostly males with lower ACT scores and high school grade averages than Non Ag sample members) suppressed overall response rates for the Ag sample.

The final step in analyzing the data involved computing response rate means for subgroups of the sample population, based on combinations of variables that are easily obtainable, to provide comparative estimates of potential response rates for these subgroups. These data, which were computed from the original survey data rather than the logistic regression function, are presented in Table 6.

Table 6: Response Rate Means for Selected Subgroups of Students

Subgroup	Response Rate Means
Males, ACT 0-13	26.1%
Males, ACT 14-18	34.1%
Males, ACT 19-23	36.0%
Males, ACT 24-36	49.2%
Females, ACT 0-13	37.2%
Females, ACT 14-18	40.4%
Females, ACT 19-23	54.1%
Females, ACT 24-36	63.5%
Black Males	29.0%
Black Females	45.2%
Hispanic Males	26.7%
Hispanic Females	43.2%
White Males	37.7%
White Females	48.6%
Black Males, ACT 0-13	14.8%
Hispanic Males, ACT 0-13	15.6%
Hispanic Males, ACT 14-18	33.3%
White Females, ACT 19-23	54.3%
White Females, ACT 24-36	64.7%

These data clearly indicate that response rates varied considerably for specific subgroups of the college bound high school population. In particular, Black males and Hispanic males with ACT scores less than 14, all males with ACT scores less than 14, all Black males, and all Hispanic males responded at much lower rates than did those in other subgroups. Females with

ACT scores above 18, on the other hand, responded at a much higher rate than other subgroups.

DISCUSSION

The results of the study indicate that knowledge of college bound high school students' demographic and academic characteristics can assist survey researchers in designing samples for mail surveys. Other variables not available for the present research, however, may play an important role in determining response/nonresponse behaviors for this particular population. Using the results of this study and the results of the previously published research cited earlier, the following model of response behavior for college bound high school students may be hypothesized.

$$\frac{R}{N} = C' + [BC + (BC * AC) + (BC * PC) + (BC * IC) + AC + PC + IC + SC], \text{ where:}$$

R = total responses received by cutoff date

N = sample size

C' = a constant

BC = effects for background characteristics

AC = effects for academic characteristics

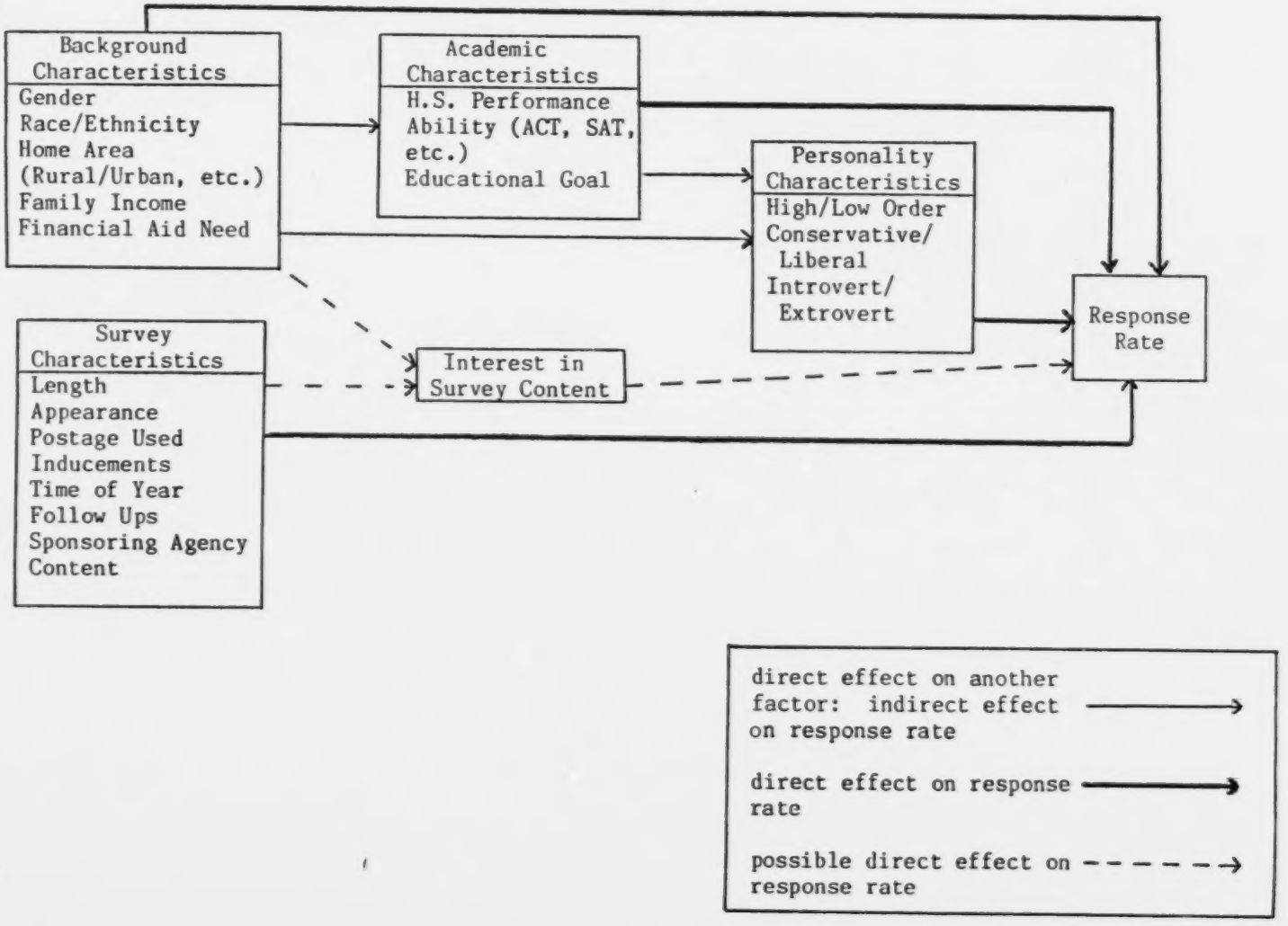
PC = effects for personality characteristics

IC = effects for interest in survey content, and

SC = effects for survey characteristics.

In the model (depicted in Figure 1), the factor entitled "Background Characteristics" is composed of variables identified in this study as related to response rate and include gender, race/ethnicity, size of home area, family income, and need for financial aid. Likewise, the factor entitled "Academic Characteristics" is composed of variables identified in this study as related to response rate and include: high school grade performance, ability (as measured by test scores), and expected educational goal. Interest in Survey

FIGURE 1: Theoretical Model of Mail Survey Response Behavior of College Bound High School Students.



Content, tentatively identified as related to response rate in this study, has been found related to response rate in previous studies (e.g., Donald, 1960). Therefore, Interest in Survey Content has been included in the model as a factor that may possibly be related to response rate. Other studies (cited earlier) indicate that mail survey response rate can be affected by questionnaire length and appearance, by the type of postage used, by the offering of inducements, by the number and type of follow-ups used, and by the agency/organization sponsoring the survey. As a result, these variables are included in the model as the factor entitled "Survey Characteristics." Finally, a number of studies (e.g., Bennett and Hill, 1964) indicate that personality characteristics are related to response behavior. The final factor in the model, therefore, is entitled "Personality Characteristics," and is composed of high/low need for order, conservative/liberal outlook, and social introvert/extrovert.

According to the a priori dynamics hypothesized for the model, Background Characteristics, Survey Characteristics, Academic Characteristics, Personality Characteristics, and, possibly, Interest in Survey Content exert a direct influence on response rate. In addition, the factor Background Characteristics also has an indirect effect on response rate through the intervening factors Academic Characteristics, Personality Characteristics, and, possibly, Interest in Survey Content. Survey Characteristics has a possible indirect effect on response rate through Interest in Survey Content. Finally, Academic Characteristics has an indirect effect on response rate through the intervening factor Personality Characteristics.

The proposed model is intended to provide a basis for continuing research on the causes underlying nonresponse to mail surveys, not as an explanation of that phenomenon. Hopefully, other researchers will examine the model, devise

methods for testing its components, and improve the model's ability to predict response behaviors for college bound high school students and, eventually, other populations of interest.

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